

# The Social Cost of Anonymity: The Limit of Arbitrage in the Bitcoin Cryptocurrency Protocol

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## 1. Introduction and Summary

**The Research Question.** U.S. PCS (payment, clearings, and settlement) systems process approximately 600 million transactions per day, valued at over \$12.6 trillion. Given that safe and efficient arrangements for conducting PCS processes are critical to the proper functioning of the financial markets, and to financial stability, it is significant to study the design of the payment system.

Bitcoin is the first digital currency for transactions among pseudonyms, recorded in the public decentralized ledger, and verified using proof of work. Bitcoin is cryptocurrency and worldwide payment system. In 2014, a venture capitalist Marc Andreessen famously said “we are quite confident that when we’re sitting here in 20 years, we’ll be talking about Bitcoin the way we talk about the Internet today” (Fung (2014)).

Bitcoin uses have grown significantly but its exchange rates with a fiat currency have been extremely volatile (daily price change 6.2% for April 2016-May 2018 while S&P500 daily price change is 0.7%), causing concerns among practitioners. For example, Federal Reserve Board Governor Lael Brainard wrote “such extreme fluctuations limit an asset’s ability to fulfill two of the classic functions of money: to act as a stable store of value that people can hold and use predictably in the future, and to serve as a meaningful unit of account that can be used to assign a comparable value of goods and services” (Brainard (2018)).

Then the research question of this paper is

*Why is it that bitcoin price is divergent from the fundamental value but the arbitrage does not work? What algorithm/market design will help the efficient bitcoin price formation?*

**Novelty of This Research.** There has been a growing literature of the analysis and design of the cryptocurrency. Athey et al. (2016) develop a theoretical model that bitcoin exchange rates and conclude “at least directionally, the forces of supply and demand appear to be operating.” This paper examines the cause of deviation of bitcoin exchange rates from fundamentals.

Kroeger and Sarkar (2016) document existence of persistent, statistically significant differences between US dollar-denominated bitcoin prices in multiple bitcoin exchanges. This paper develops an economic mechanism that explains such price differences.

Chiu and Koppel (2017) find that the cryptocurrency reward structure is too generous so that too many resources are being used to rule out double-spending and making it a secure

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